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Vegetable & Fruit News

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Thank You from Joanne

By Joanne Whalen
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October 20, 2016

As many of you know, I will be retiring from the University of Delaware and my official last day is January 1, 2017. I want to take this opportunity to say thank you to all of my wonderful producer cooperators, as well as to all of my colleagues and friends in the ag industry including the faculty, agents, specialists and support staff at UD, DSU and surrounding states, agrichemical reps, private consultants, vegetable processors, Delaware Department of Ag, USDA and NRCS and all who have worked with me over the years. It is the relationships that we build in Cooperative Extension that have made this such an awesome career. We have worked as a team and the success of IPM in Delaware and the Mid-Atlantic is a result of all of your help and assistance over the years.

I wish all of you the best of luck in future years... and I am sure you will see me at a meeting or two!!
Your Friend,
Joanne

Avipel Special Local Needs (SLN) 24-C Labels for Management of Blackbirds and Crows in Field Corn and Sweet Corn in Delaware in 2017: I wanted you all to be aware that the 24C SLN (24-C) label for the use of Avipel Hopper Box (Dry) has been renewed for the 2017 season. In addition, there will also be a SLN (24-C) label for the Avipel Liquid Seed Treatment (commercially applied only) for the 2017 season. Both labels will expire July 15, 2017. If you have questions, please call me at 302-530-8948 or send an e-mail to jwhalen@udel.edu.

For more information on how to use these products as well as a copy of the 24C labels, which must be in your possession to use, please visit Arkion's website at: http://arkionls.com/av/states/delaware.html

If You Can't Take the Heat, Stay out of the Mulch: How Mulching Practices Affect Spotted Wing Drosophila Survival in Blueberries

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The Problem: Spotted wing drosophila (SWD), native to Southeast Asia, has become a major pest of small fruit crops, especially blueberries, blackberries, and raspberries in the U.S. Unlike other fruit flies, it can successfully lay eggs through the skin of ripening fruit. It also reproduces very quickly, so populations can explode over a relatively short period of time. The larvae develop in the ripening fruit on the plant and may also continue development when the fruit drops to the ground. They then either pupate in the fruit, or leave the fruit to pupate in the soil surrounding the plant. We are looking into ways that the crop environment can be manipulated to make it unfavorable for SWD development, specifically, whether different mulching practices affect SWD survival both above and below the mulch surface.

The Plan of Attack: The research was conducted with experiments in blueberries at research farms in Queenstown (WyeREC) and Keedysville (WMREC), MD. The blueberries were managed without foliar insecticides or fungicides. We used two mulching treatments, woven black weed fabric (over woodchips, Fig. 1) and bare woodchip mulch (Fig. 2). To determine how this impacts SWD, we measured SWD survival in fruit, survival of SWD pupae, and the temperature SWD experienced above and below both mulches for two one week periods during the growing season.

Fig. 1 Temperature loggers and woven black weed fabric mulch.

Fig. 2 Temperature loggers and wood chip mulch.

How hot did it get? Research suggests that SWD do not continue development at temperatures greater than 87.6 degrees Fahrenheit[a], so we were interested to see how many times the data loggers took a measurement above that temperature during both deployment weeks. For both sites, loggers recorded more temperature events warmer than 87.6°F above the mulch than below for each mulch type (Fig. 3). However, at WyeREC, there were many fewer temperature events above 87.6°F recorded below the mulch than above the mulch when compared to WMREC (Fig. 3).

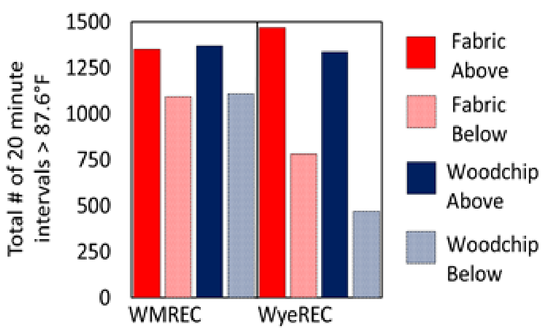

Fig. 3 Number of times data loggers recorded a temperature event greater than 87.6°F over two weeks.

How did SWD do in fruit? To determine how well SWD would do if they were protected inside the fruit, groups of blueberries infested with ~50 SWD eggs total were placed either above or below the mulch treatments in our blueberry plots for one week. We then returned them to the lab and assessed for percent survival. This was done twice during the growing season. At WMREC, no SWD made it to adulthood either above or below the mulch for both mulch types during both deployments (Fig. 4). At WyeREC, no SWD made it to adulthood in either mulch type when left above the mulch. There was an average of ~5% survival below the weed fabric mulch, and an average of ~35% survival below the woodchip mulch (Fig. 4). For comparison, ≥ 66.0% survived when fruit were held in the lab instead of deployed.

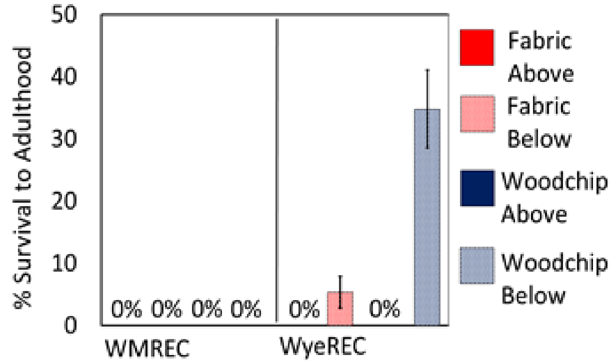

Fig. 4 Percent SWD surviving to adulthood by mulch type and location above and below mulch.

How did SWD pupae do? Because SWD may leave the fruit prior to reaching the mulch, bare pupae were also evaluated. Twenty SWD pupae were attached to card stock with double sided tape, enclosed in a metal mesh cage to prevent crushing (Fig. 5), and deployed in the field either above or below the mulches for one week before being returned to lab for assessment of survival to adulthood. This was done twice during the growing season. At WMREC, survival both above and below the mulch for both mulch types was consistently low (less than 10% for all treatment combinations) (Fig. 6). At WyeREC, the lowest survival occurred above the weed fabric mulch (~5%), while the highest survival occurred below the woodchip mulch (~65%) (Fig. 6). When pupae are held in the laboratory as a control, ≥87.5% survive.

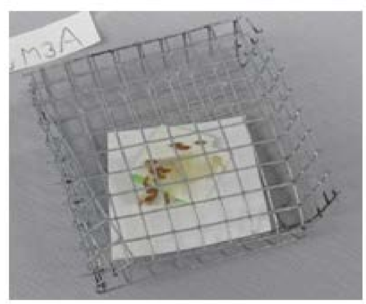

Fig. 5 SWD pupae in deployment cage.

SWD can't take the heat. SWD survival was impacted by mulch type and their location within the mulch. At WMREC, survival was consistently very low both in fruit and as pupae, and temperature readings suggest that it got hotter than they could handle across both mulch types and both locations within the mulch. At WyeREC, it was much cooler below the mulches than above them, and survival of SWD was better below the mulch than above the mulch for both mulch types. However, survival was better below the woodchips than below the weed fabric. This suggests that other factors such as mulch structure or humidity might also impact survival.

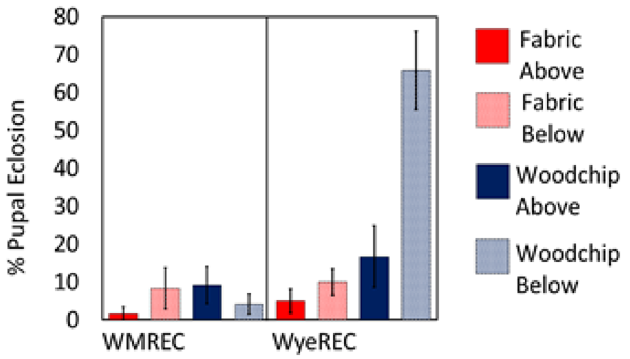

Fig. 6 Percent pupae surviving to adulthood by mulch type and location above and below mulch.

Future Directions: These studies will be replicated over the next three years in blueberries, and possibly in red raspberries. We are also exploring other ways to manipulate the plant environment, including different pruning treatments in blueberries and red raspberries.

Acknowledgements: We would like to thank our funding sources, the USDA-NIFA OREI Grant # 2015-07403 and the MAES Competitive Grants Program. We also thank Margaret Lewis, Shulamit Shroder, Adrienne Beerman, and Aditi Dubey for their assistance with setting up various aspects of the studies.

Reference Cited: [a]Ryan GD, Emiljanowicz L, Wilkinson F, Kornya M, Newman JA. 2016. Journal of Economic Entomology DOI: 10.1093/jee/tow006

Heat Tolerant Lettuce Cultivars in a Blazing Hot Summer

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Introduction

When lettuce (*Lactuca sativa)* is grown in the mid-Atlantic region, it is usually for baby greens and is never grown in summer. In heat, lettuce bolts and produces latex, making the lettuce taste bitter. In an effort to enhance East Coast lettuce production, we tested the ability of four lettuce cultivars that were advertised as 'heat-tolerant' to resist bolting. They were grown in four different mulching conditions - white plastic mulch, black plastic mulch, straw, bare ground, and vermicompost covered by white plastic. The aim of these variables were to test if slight changes in light reflection and absorption could change the immediate temperature surrounding the plant. An additional treatment of germination temperature was also added to each mulch block. Half of the lettuce was germinated at 20°C (68°F) while the other half was germinated at 30°C (86°F) in an effort to create a sort of priming effect for heat-tolerance. These two variables – germination temperature and mulch treatment – were chosen as they are readily available to the farmer.

Fig. 1: Lettuce plots at time of transplant at the WyeRec in Queenstown, MD.

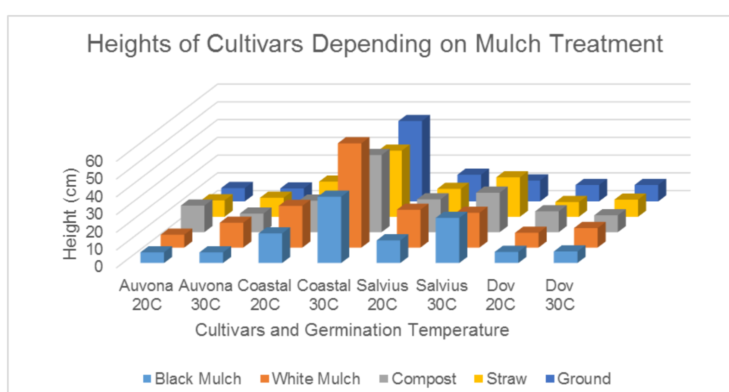
Methods

The lettuce varieties were transplanted at the Wye Research and Education Center in Queenstown, MD on June 28, 2016. Three of the varieties, "Coastal Star", "Auvona", and "Salvius", were from Johnny's Seeds. The fourth variety, "Dov", is an organic seed from Sustainable Seed Co. All four were cos varieties. Those seeds germinated at 20°C (68°F) were grown in a growth chamber for six weeks. Those germinated at 30°C (86°F) were grown in a greenhouse for five weeks. These four cultivars were transplanted onto different mulch types – white plastic, black plastic, straw and bare ground – in a randomized block design. At the time of transplant, they were watered in with fertilizer and received overhead irrigation. This continued throughout the trial. Temperature of the center of the lettuce head, surrounding soil, and mulch, was measured using an infrared thermometer on August 2, 2016. After six weeks in the field, the heads of lettuce were harvested. Fresh weight and stem length were measured. During this time, some lettuce cultivars bolted. Those cultivars that did not bolt were considered more heat-tolerant.

Results and Discussion

How did germination temperature affect the lettuce? The lettuce germinated at 20°C (68°F) was generally less likely to bolt than those germinated at 30°C (86°F). However, the average difference in height between these two treatments depended on the cultivar (Fig. 2). "Coastal Star" appeared to be the least tolerant to heat, and the 20°C germination temperature treatment had the largest impact at delaying bolting. "Dov" was more heat-tolerant, and the germination temperature had less of an effect on the height of the lettuce stem.

Fig. 2: Average height of each cultivar depending on germination temperature and mulch treatment.



Sweet Corn Insect Control and Efficacy of the Transgenic Bt Technology

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Sweet corn producers must rely on timely pest monitoring and effective insecticide sprays to control ear-invading insects. In the Mid-Atlantic, corn earworm is the primary ear invader, followed by sap beetles, fall armyworm, and European corn borer as secondary pests. The level of infestation varies with the year, time of season, and location. For instance, corn borer infestations have been very low during the past decade due to regional population suppression resulting from the high adoption of Bt field corn. Still, corn earworm infestations typically can cause damage on 10 to 25% of the ears in early plantings, and often greater than 50% ear damage in late plantings if not controlled. Insecticide control programs are costly, pose exposure risks to the applicator and farm workers, and require considerable time and management to implement.

The cheaper pyrethroid (Group 3A) insecticide products have been the popular choice, but control efficacy has significantly declined due to resistance in corn earworm populations. Spray mixtures of Lannate® (Group 1A) plus a pyrethroid are often used to circumvent the resistance problem and improve control of sap beetles. Rotations and mixtures with different active ingredients such as Coragen (Group 28), Radiant (Group 5), Blackhawk (Group 5), as well as premix products (i.e. Besiege (Group 3A + 28), Voliam Xpress (Group 3A + 28) are also increasingly used and can provide good control. However, the reality is that pyrethroids are no longer providing enough ear protection on many farms, so it is becoming necessary to switch or rotate to one of these alternative products. For all insecticide products, timing the first spray at early silking, applying subsequent sprays on a schedule that is based on moth pressure, and achieving adequate spray coverage of the ear zone are critical components of effective control. Most corn earworm eggs are laid directly on the silks; once larvae hatch, they quickly move down the silk channel and begin feeding on the ear tip, where they are protected from insecticidal sprays. Thus, it is absolutely necessary to target the larvae before they enter the ear by protecting silk tissue when moth pressure is high.

These problems and challenges with conventional insecticide applications can essentially be eliminated with Bt technology. Transgenic Bt technology expresses insect-active toxins from the bacterium, *Bacillus thuringiensis* (Bt) in tissues of the sweet corn plant. This technology has revolutionized the way many corn insect pests are managed, particularly European corn borer, which is virtually 100% controlled by Bt sweet corn. However, the expressed toxins alone do not always provide 100% control of corn earworm or fall armyworm, and thus supplemental insecticide sprays are often needed to ensure quality sweet corn ears, especially during high moth activity. For Bt sweet corn production, there are three types commercially available: Attribute® hybrids (expressing Cry1Ab toxin), Attribute® II hybrids (expressing Cry1Ab and Vip3A), both from Syngenta Seeds, and Performance Series™ hybrids (expressing the Cry1A.105 and Cry2Ab2 toxins) from Seminis Seeds. Expression of the Bt toxin in these hybrids is highly effective against European corn borer, eliminating all whorl and silk sprays in areas where this pest is the primary problem. However, efficacy of Cry1Ab sweet corn for controlling corn earworm has been highly variable since 2008, with increasing concerns over lack of field efficacy. In this article, we present research findings from 21 years of monitoring changes in field efficacy in Bt sweet corn, as evidence of resistance development in corn earworm populations to multiple Cry toxins.

Plots of Bt sweet corn paired with non-Bt hybrids (same genetic line as Bt hybrid) were established at five University of Maryland Research and Education farm facilities (Salisbury, Wye, Beltsville, Upper Marlboro, and Clarksville) from 1996 to 2016 to evaluate corn earworm infestations in ears as a direct measure of efficacy. Plots were not sprayed, so any ear protection observed was a result of the Bt technology. Attribute® hybrids were evaluated during all years, whereas Performance Series™ and Attribute® II hybrids expressing pyramided Bt toxins were developed later and included in trials from 2008 to 2016, alongside Attribute® sweet corn at the same locations. All plots were planted during June to encourage high infestations of corn earworm and sampled to assess ear damage when ears reached fresh market maturity. The following variables were recorded as measures of control efficacy against corn earworm: percentage of ears damaged, kernel area consumed, average instar stage of larvae, and the proportion of late instar (4th – 6th instars) found in ears.

Attribute® hybrids from Syngenta Seeds have been commercially available since 1996, and acreage has increased significantly with the introduction of improved fresh market hybrids and availability of 25K seed units for smaller producers. When first introduced, expression of Cry1Ab toxin in these hybrids provided greater than 95% control of all worms, with very minor injury to a few kernels at the ear tip and only early instar larvae if present (**Fig. 1**). The ear protection allowed producers to eliminate pre-silk treatments and reduce insecticide applications during silking by 70 to 90%.

Figure 1. Representative level of ear protection during 1996-2000 by Attribute® sweet corn (GSS0966) compared to the non-Bt Prime Plus hybrid (right) planted at the same time and exposed to high corn earworm and fall armyworm pressure.

However, ear damage, kernel consumption, instar age, and proportion of late instars have progressively increased since 2000 in Attribute® hybrids. The upper ears in **Fig. 2** shows the representative ear damage typical of BC0805 Bt sweet corn under high corn earworm pressure during 2010-2016. Based on 89 trials evaluated, the percentage of ears damaged in Attribute® Cry1Ab expressing hybrids increased from less than 10% in 1996 to an average of 84% in 2016. The amount of kernel area consumed has more than tripled during the same time, and the proportion of live larvae reaching later developmental stages in ears has increased from less than 5% in 1996 to an average 81% in 2016. These results clearly demonstrate the reduced efficacy of Attribute® sweet corn, and indicate increased resistance in corn earworm populations to the

Cry1Ab toxin. This reduction in efficacy was unrelated to corn earworm pressure, because moth activity monitored in blacklight traps has actually declined over the past decade at the farm sites. Sweet corn producers in the Mid-Atlantic growing Attribute® hybrids can apply insecticide sprays to compensate for the reduced efficacy.

Figure 2. Representative level of ear protection during 2010-2016 by Attribute® sweet corn (BC0805, upper ears) compared to the non-Bt Providence hybrid (lower ears) planted side by side and exposed to high corn earworm and fall armyworm pressure.

Seminis Seeds has developed and is now marketing pyramided Bt sweet corn under the Performance Series™ trade name. Some Bt hybrids available are Temptation, Obsession, Passion, and SV9010SA. These hybrids express three insecticidal toxins: Cry1A.105 and Cry2Ab to control lepidopteran larvae, and Cry3Bb1 to control rootworms, as well as herbicide tolerant traits. When this Bt sweet corn was first evaluated in 2010, control efficacy was similar to the level of ear protection by Attribute® hybrids in the late 90’s, providing 100% control of fall armyworms and more than 95% control of corn earworms, with very few surviving larvae and only minor injury on the ear tip. However, control efficacy rapidly declined during the last three years, as evident in **Fig. 3** showing unacceptable levels of earworm damage on the ear tip of both single and pyramided Cry-expressing sweet corn. Note that the Attribute® ears show extensive feeding injury by fall armyworm on the side kernels, whereas the Obsession II ears are undamaged by this pest. Six late plantings of Performance Series™ hybrids at research farm sites in 2016 averaged 67% damaged ears with 74% of the surviving corn earworms reaching the late developmental stages.

Figure 3. Representative level of ear protection during 2016 by Attribute® sweet corn (BC0805, left) compared to Performance Series™ sweet corn (Obsession II, right). Both hybrids were planted side by side and exposed to high corn earworm and fall armyworm pressure.

The Attribute® II type of Bt sweet corn by Syngenta Seeds expresses a new Bt gene combination to broaden the spectrum of activity and reduce resistance development. Introduced commercially in 2013, this sweet corn expresses a novel vegetative insecticidal toxin, Vip3A, from *B. thuringiensis*, pyramided with the Cry1Ab toxin. The Vip3A toxin is highly effective against a range of important lepidopteran pests including black cutworm, fall armyworm, corn earworm, and western bean cutworm. Of 13 field trials comparing Attribute® II hybrids with non-Bt hybrids, no live larvae and virtually no ear damage were found in the pyramided hybrids, indicating 100% control efficacy of corn earworm, fall armyworm and European corn borer. The non-Bt hybrids, without insecticide protection, averaged between 43 and 100% ears infested with late instar larvae. **Figure 4** illustrates the level of ear protection by the Vip3A + Cry1Ab expressing Attribute® II hybrid Remedy, compared to Obsession II.

Figure 4. Representative level of ear protection during 2016 by Attribute® II sweet corn (Remedy, left) compared to Performance Series™ sweet corn (Obsession II, right). Both hybrids were planted side by side and exposed to high corn earworm and fall armyworm pressure.

In summary, the field-evolved resistance and associated reduction in efficacy reported here confirm the findings from a recent study in South and North Carolina[1] showing evidence of developing resistance to the Cry1Ab trait in field corn based on changes over time in toxin inhibition on growth and development of corn earworm. However, corn earworm resistance could be localized to some extent because Attribute® hybrids still provide moderate to high control efficacy in other areas, particularly northern states where corn earworm does not overwinter. Many factors can contribute to development of insect resistance. It is thought that the relatively low acreage of Bt sweet corn hybrids is unlikely to have exerted enough selection pressure alone to account for changes in corn earworm susceptibility, despite being planted without a refuge requirement. The high adoption rate of Bt field corn and cotton, with the

Cry1Ab toxin being used in Bt field corn since 1996, has contributed to the selection pressure on earworm populations. Additionally, Cry1Ab and related Cry1Ac toxins are expressed at a moderate dose in these crops and refuge compliance is decreasing, which together have probably contributed significantly to the evolution of resistance. In Maryland, the adoption rate of Bt field corn is very high, accounting for 83-93% of the acres planted during 2013 in crop reporting districts where the trials were conducted. This high adoption of Bt corn, along with a presumed decline in compliance with the refuge requirements, has almost certainly contributed to the local evolution of resistance. Unfortunately, corn earworm resistance to the Cry toxins is likely to increase, and spread, with the shift to 'refuge in bag' corn hybrids that contain a blend of 95% Bt and 5% non-Bt seeds. Similarly, due to northward influxes of potentially resistant moths from southern source regions, the risk of further evolution of resistance may increase with the reduced refuge size (from 50% to 20%) in regions where Bt cotton is used. Apart from reductions in the refuge size, there are also concerns that pollen-mediated gene flow between Bt and refuge plants in a seed blend could accelerate resistance evolution. Finally, the potential existence of cross resistance between Cry1Ab and the other Cry toxins may also compromise the efficacy and durability of the new pyramided traits in Bt field and sweet corn.

[1]Reisig, D.D. and F.P.F. Reay-Jones. 2015. Inhibition of *Helicoverpa zea* (Lepidoptera: Noctuidae) growth by Transgenic Corn Expressing Bt Toxins and Development of Resistance to Cry1Ab. Environ. Entomol. DOI: 10.1093/ee/nvv076

Optimizing Carrier Water Volume for Enhanced Spray Coverage in Raspberries

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In small fruit production, spray coverage can strongly influence the effectiveness of a given pesticide treatment. Many fruit species, including blueberries, blackberries, and raspberries, develop a dense foliar canopy as they mature. This can block pesticide sprays from penetrating the entire bush and create areas of refuge for key pests, providing a means for their populations to persist despite regular insecticide treatments.

Spray coverage may be important for managing spotted wing drosophila (SWD). Many of the insecticides used to manage SWD primarily target adults and require direct contact. A recent study in blackberries reported higher rates of larval infestation in the center of the bush, a pattern that held true regardless of insecticide sprays, harvest status, and other management decisions[1]. This suggests that there may be higher rates of SWD egg-laying in the inner canopy of its host plants and that failure to spray this region of the bush with insecticides may create a refuge that allows SWD populations to build up.

In this study, our primary objective was to improve spray coverage in fall-fruiting red raspberries, particularly in the inner canopy. In many systems, increasing the spray volume has been shown to improve pesticide coverage, including on spray cards elevated above bare ground[2] and in grapes[3]. We hypothesized that using a higher spray volume would also result in improved spray coverage in red raspberries, particularly in the inner canopy.

Methods: Spray trials were conducted at the Western Maryland Research and Education Center (Keedysville, MD) on two dates: 8/31/2016 and 9/21/2016. Fall fruiting red raspberries were sprayed with Brigade® 2EC and Mustang® Maxx on 8/31 and 9/21 respectively. Treatments were applied using two spray volumes, 50 and 100 gallons per acre (GPA**),** with a Durand Wayland 100 Sprayer, which had a 24-inch fan; the bottom 3 nozzles were turned on (Figure 1).

Figure 1. Spray treatment application at Keedysville

Figure 2. Spray cards deployed in the inner (A) and outer (B) canopy at Keedysville prior to treatment

Treatments were applied at 3 mph/150 psi using two sets of nozzles, one set calibrated to 50 GPA and the other to 100 GPA.

On the first trial date, the sprayer was set to be used primarily on tree fruit, resulting in very low coverage on the lower half of the raspberry bush. On the second trial date, we lowered the sprayer to its lowest height setting and adjusted the angle of the nozzles, turning the two lowest sets of nozzles downward, which increased the amount of spray hitting raspberry foliage.

To visualize pesticide deposition, Vision Pink Foam Marker Dye (Garrco Products Inc.) was added to the tank mix at a rate of 32 oz per 100 gallons. White Kromekote spray cards were deployed in both the inner and outer canopy of the raspberry bush at three heights: low (1.5 feet above the ground), medium (3.0 feet above the ground), and high (4 feet above the ground) (Figure 2). After the pesticide residues dried, spray cards were collected and scanned. We calculated the percentage of the card dyed pink (percent coverage) using ImageJ software.

After completing the trials, spray coverage was also measured on a commercial grower farm on 9/28/2016 in fall fruiting red raspberries. Treatments were applied using a Tifone Storm 1032 airblast sprayer at 56 GPA and 220 psi/2.3 mph, with the bottom 3 nozzles turned on.

Results: Percent coverage varied significantly in response to both spray volume and the spray card's location in the canopy. Overall, spray coverage was higher in the outer canopy relative to the inner (Figure 3). Coverage rates were variable, even when grouped by spray volume and spatial location. For example, at Keedysville on 8/31, coverage in the inner-high canopy ranged from 7.19 - 94.77% at 100 GPA. The main factor contributing to this variability was the amount of foliage covering the spray cards; even at 100 GPA, dense foliage limited pesticide dispersion throughout the canopy.

Spray coverage also varied by height. At our commercial farm site, coverage tended to be lowest at the bottom of the raspberry canopy (Figure 4). Similarly, at Keedysville on 8/31, coverage was very poor at the low canopy height, regardless of spray volume (Figure 3, 5).

Spray coverage in the lower canopy did

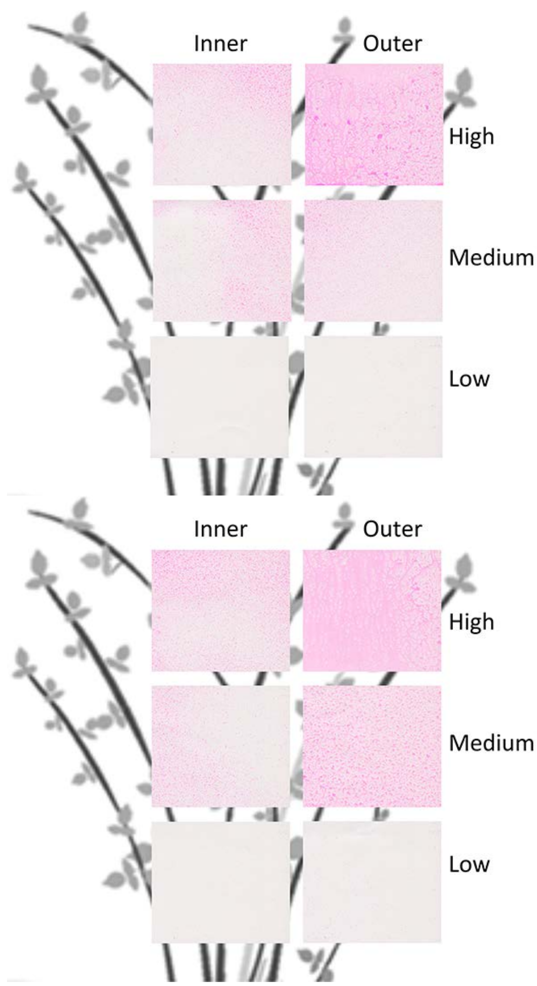


Figure 3. Average spray coverage at six locations throughout canopy at 50 GPA (top figure) and 100 GPA (lower figure) from spray trials conducted at Keedysville on 8/31/2016.

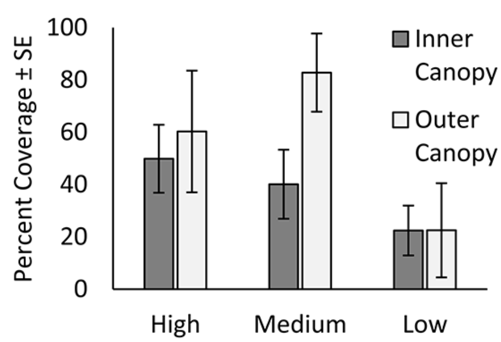


Figure 4. Average percent coverage at six locations throughout the canopy on a commercial grower farm on 9/28. Treatments were applied using a spray volume of 56 GPA and coverage was measured at three distinct heights within the inner and outer canopy: lower (1.5 feet about ground), medium (3.0 feet above ground), and high (4.0 feet above ground).

improve when we repeated the trial on 9/21. In the outer-low canopy, coverage averaged 53.41% at 100 GPA and 29.40% at 50 GPA (Figure 6). This increase was most likely due to the sprayer adjustments described earlier.

There were no significant differences in coverage between 50 and 100 GPA in the inner canopy on either trial date, regardless of height (Figures 5-6). However, the higher spray volume did improve coverage in the outer canopy. On 8/31, differences in percent coverage between 50 and 100 GPA varied depending on spray card height (Figure 5). There were no differences between spray volumes in the lower canopy. But, at medium height, coverage averaged 80.97% at 100 GPA, compared to 32.10% at 50 GPA. Percent coverage was also marginally higher at 100 GPA in the high canopy (Figure 5). On 9/21, percent coverage was significantly higher at 100 GPA across all heights in the outer canopy (Figure 6).

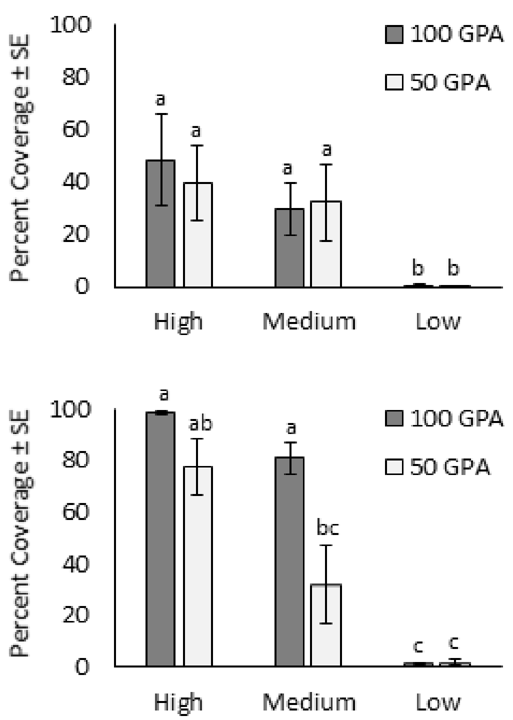
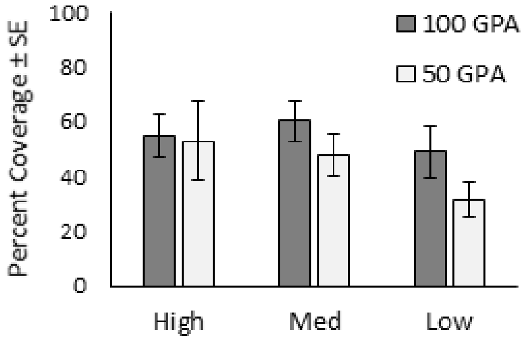


Figure 5. Average percent coverage of spray cards from the 8/31/2016 spray trail at Keedysville in the inner (top figure) and outer (lower figure) canopy. Spray treatments were applied at 50 and 100 gallons per acre (GPA) and coverage was measured at three distinct heights within the canopy: lower (1.5 feet about ground), medium (3.0 feet above ground), and high (4.0 feet above ground).

Discussion/Conclusions: Increasing the carrier water volume improved coverage in the outer canopy, but did not have any significant effects in the inner canopy. This suggests that increasing the carrier water volume alone may not be enough to ensure adequate spray coverage. Further study is needed to determine the best system for growers to optimize spray coverage.

One step that can easily be taken towards optimizing spray coverage is to check that your sprayer and nozzles are oriented correctly for the crop you are spraying. In the first round of the Keedysville trial, we achieved less than 1% coverage in the bottom portions of the raspberry canopy. Most of the spray appeared to have been directed upwards and never reached the raspberry bush. This issue was remedied by lowering the sprayer and lowering the angle on the bottom two sets of nozzles. We were able to roughly visualize the area of space that would be sprayed by running water through it prior to putting out the treatments.

Insecticides are currently the most effective management tool available for SWD. However, in many of the fruits susceptible to SWD, achieving good spray coverage is difficult, which may be limiting the benefits you receive from a pesticide application. In 2017, we will continue this study, including an additional bioassay component to correlate spray coverage with SWD mortality and continued evaluation of spray coverage under different management systems.



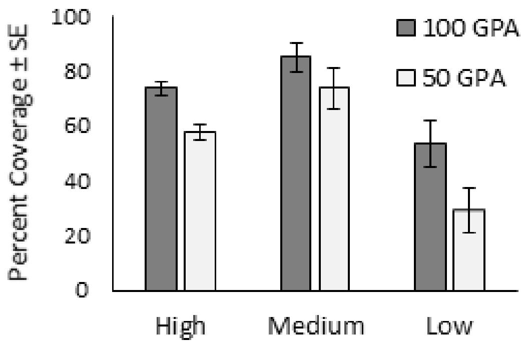


Figure 6. Average percent coverage of spray cards from the 9/21/2016 spray trial at Keedsyville in the inner (top figure) and outer (lower figure) canopy. Spray treatments were applied at 50 and 100 gallons per acre (GPA) and coverage was measured at three distinct heights within the canopy: lower (1.5 feet about ground), medium (3.0 feet above ground), and high (4.0 feet above ground). There were no significant differences in coverage in the inner canopy, but in the outer canopy, spray coverage was significantly higher at 100 GPA

Acknowledgements: Thanks to Galen Dively and Douglas Price for helping apply spray treatments at Keedysville, to Adrienne Beerman, Shulamit Shroder, Jessica Van Horn, and Claire Weber for helping prepare and process spray cards, and to our cooperating growers for allowing us to use their sites. Vision Pink Foam Marker Dye samples were provided by GarrCo Products Inc. (Converse, IN). Funding was provided by the Maryland State Horticultural Society.

[1] Diepenbrock, L.M., and Burrack, H.J. 2016. Variation of within-crop microhabitat use by *Drosophila suzukii* ((Diptera: Drosophilidae) in blackberry. Journal of Applied Entomology.

[2] Nansen, C., Ferguson, J.C., Moore, J., Groves, L., Emery, R., Garel, N., and A. Hewitt. 2015. Optimizing pesticide spray coverage using a novel web and smartphone tool, SnapCard. Agron. Sustain. Dev. 35: 1075-1085.

[3] Wise, J.C., Jenkins, P.E., Schilder, A.M.C., Vandervoort, C., Isaacs, R. 2009. Sprayer type and water volume influence pesticide deposition and control of insect pests and diseases in juice grapes. *Crop Protection*. 29: 378-385.

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University of Maryland and University of Maryland Extension Team Up to Offer Combined FDA-Approved FSMA Trainings

Rohan Tikekar, an assistant professor in the Department of Nutrition and Food Science at the University of Maryland, along with a team of university and university extension collaborators, was recently awarded a USDA NIFA Food Safety Outreach Program grant to offer FDA-approved FSMA trainings throughout the state. The trainings combine curricula from the two Food Safety Modernization Act (FSMA) rules that will impact farmers and processors the most: the Produce Safety and Preventive Controls rules.

The goal is to consolidate training and minimize costs for those growers who are also processing and need to get these certifications. Other collaborators include Justine Beaulieu, a Faculty Assistant and Good Agricultural Practices (GAP) Educator in the Department of Plant Sciences and Landscape Architecture; David Martin, a UME Senior Agent in Baltimore County; Ginger Myers, a UME Agent Associate in Western MD; and Shauna Henley, a UME Agent also in Baltimore County.

Tikekar is a Lead Trainer for the FDA's Food Preventive Controls Alliance (FPCA) Preventive Controls training and will be leading that part of the course, while Beaulieu and Martin are Produce Safety Alliance (PSA)-certified trainers and will be helping to teach the Produce Safety rule course. Each training will be four days long (one day for produce safety and three for preventive controls). Attendees will earn their certifications while gaining a comprehensive understanding of how to conduct risk analyses in growing and processing.

The team will hold the trainings in three locations throughout the state:

February 8-11, 2017 at Baltimore County extension office, Cockeysville, MD

February 22-25, 2017 at Wye Research and Education Center, Queenstown, MD

March 8-11, 2017 at Western Maryland Research and Education Center, Keedysville MD

The cost will be $20 for produce safety training only, $40 for PC rule training only, and $50 for the combined training.

To register, use the link: https://goo.gl/forms/zgkLb5JZmdBHlCtj2 or QR code or contact Rohan V. Tikekar (301-405-4509, rtikekar@umd.edu) or Justine Beaulieu (301-405-7543, jbeauli1@umd.edu)

Registration

Fall & Winter Extension Meetings

Agronomy Meetings

Washington County Crops Conference

November 28, 2016. 9:30 a.m. – 2:30 p.m.

Washington County Agriculture Education Center, 7313 Sharpsburg Pike, Boonsboro, MD 21713

Register by calling the Washington County UME Office at 301-791-1304 or jsemler@umd.edu.

Southern Maryland Crops Conference

November 30, 2016. 4:00 p.m. - 8:30 p.m.

Baden Fire Hall, Baden, Maryland.

Register by calling the Charles County UME Office at 301-934-5403.

Northern Maryland Field Crops Day

December 8, 2016. 8:45 a.m. - 3:30 p.m.

Friendly Farm, Foreston Road in Upperco, Maryland.

Register by calling Baltimore County UME Office at 410-887-8090 or visit our webpage: http://extension.umd.edu/baltimore-county

Lower Shore Agronomy Day

January 19, 2017. 8:30 a.m. – 3:00 p.m.

Somerset County Civic Center

11828 Crisfield Lane, Princess Anne, MD

Register at the Somerset County UME Office at 410-651-1350.

Cecil County Winter Agronomy Meeting

January 25, 2017. 8:30 a.m. to 3:00 p.m.

Calvert Grange, Rising Sun, Maryland.

Register by calling the Cecil County UME Office at 410-996-5280 or dbehnke@umd.edu.

Carroll County Mid-Winter Farm Meeting

February 9 2017. 9:30 a.m. - 2:30 p.m.

Carroll County Ag Center, Westminster, Md.

Register by calling the Carroll County UME Office at 410-386-2760.

Harford County Agronomy Day

February 14, 2017. 8:30 a.m. - 3:30 p.m.

Deer Creek Overlook at Harford 4-H Camp

8 Cherry Hill Road, Street MD 21154

Register by calling the Harford County UME Office at 410-638-3255 or emailing sbh@umd.edu with your name and phone number.

Caroline County Agronomy Day

February 22, 2017. 4:30 p.m.

Caroline County 4-H Park

8230 Detour Rd, Denton, MD 21629

Register by calling the Caroline County UME Office at 410-479-4030.

Montgomery-Howard-Frederick Agronomy Day

February 22, 2017. 9 a.m. – 3p.m.

Urbana Fire Hall

3602 Urbana Pike, Frederick, MD 21704

Register by calling the Montgomery County UME Office at 301-590-2809.

Queen Anne's Agronomy Day

March 3, 2017. 8:00 a.m. - 1:00 p.m.

Queen Anne's County 4-H Park

101 Dulin Clark Road, Centreville, MD 21617

Must pre-register. Register by calling the Queen Anne's County UME Office at 410-758-0166.

Organic Meeting – Grain and Vegetable

TBA. 8:00 a.m. - 1:00 p.m.

Chesapeake College, Wye Mills MD

Must pre-register. Register by calling the Queen Anne's County UME Office at 410-758-0166.

Delmarva Hay and Pasture Conference

January 10, 2017. 9:00 a.m. - 3:30 p.m.

Delaware Ag Week. Harrington Delaware

Southern Maryland Forage Conference

January 11, 2017. 8:00 a.m. - 3:30 p.m.

Baden Fire Hall, Baden, Maryland.

Register by calling the St Mary's UME Office at 301 475-4484.

Tri-State Hay and Pasture Conference

January 12, 2017. 9:00 a.m. - 3:30 p.m.

Salisbury Fire Hall, PA

Register by calling the Garrett County UME office at 301-334-6950.

Vegetable Meetings

Alternative Specialty Crop Workshop

December 13, 2016. 8:30 a.m. to 4:30 p.m.

Western Maryland Research and Education Center, Keedysville MD

Register Email: ddant@umd.edu

Phone: 410-827-8056 X115

Central Maryland Vegetable Growers Meeting

January 27, 2017. 8:45 a.m. to 3:30 p.m.

Friendly Farm, Foreston Rd. in Upperco, MD.

Register by calling UM Extension Baltimore County Office at 410-887-8090 or visit our webpage:

http://extension.umd.edu/baltimore-county

Eastern Shore Vegetable and Fruit Meeting

February 7, 2017. 8:00 a.m. to 4:00 p.m.

Cambridge MD.

Register call the Dorchester County Extension Office at 410-228-8800.

Southern Maryland Vegetable and Fruit Meeting

February 9, 2017. 8:00 a.m. to 4:00 p.m.

Location TBA

Fruit Meeting

Western Maryland Fruit Meeting

February *16 or 23*. 8:00 a.m. to 4:00 p.m.

Western Maryland Research and Education Center, Keedysville MD

Register email sbarnes6@umd.edu or call 301 432-2767 ext.301.

Vegetable & Fruit News

A timely publication for the commercial vegetable and fruit industry available electronically in 2016 from April through October on the following dates: May 13; June 9; July 21; August 18; September 16; and October 20.

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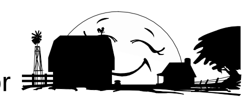

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